

RELATIONSHIP BETWEEN AFTER-SCHOOL PHYSICAL  
ACTIVITY AND DIETARY HABITS  
WITH CARDIO-METABOLIC RISK  
IN LOW-INCOME CHILDREN

by

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## ABSTRACT

Childhood obesity is a major focus of public health. The high rates of childhood obesity can be partially attributed to the increased availability and consumption of energy-dense and nutrient-poor foods and excess time spent in sedentary behavior. The purpose of this study was to determine whether after-school physical activity and dietary habits predict cardio-metabolic risk in a sample of ethnic minority elementary-school-aged children from low-income schools. Participants were a convenience sample of 92 children (3<sup>rd</sup>-6<sup>th</sup> grades) recruited from four Title I schools located in a metropolitan area from the Mountain West region of the United States. Children completed portions of the After School Student Questionnaire (ASSQ) and Physical Activity Questionnaire for Children (PAQ-C) to measure after-school physical activity and nutrition. Blood pressure, waist circumference, and cardio-metabolic blood markers were collected in a fasted state before school hours to calculate a continuous metabolic syndrome (MetS) composite score. Predictive relationships were analyzed using a multiple linear regression model. Neither physical activity nor nutrition were predictive of a MetS score. However, there was a linear, positive, and moderate correlation between physical activity and nutrition scores ( $r = 0.29, p < 0.05$ ). In a secondary analysis, a linear regression established the relationship between after-school physical activity and nutrition. The linear model indicated that a one-unit increase in PA score was associated with 1.28-unit increase in nutrition score. The findings indicate that cardio-metabolic health cannot be

predicted based on self-reported after-school physical activity and nutrition habits; however, self-reported PA and nutrition habits are linearly related. Overall, the majority of children in this study exhibited favorable cardio-metabolic health. In fact, 84.8% of the subjects had two or fewer of the risk factors for metabolic syndrome and 40.2% of subjects displayed none of the risk factors. Further research is needed in determining whether after-school physical activity and nutrition habits influence cardio-metabolic health.

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## INTRODUCTION

The childhood obesity epidemic remains a major focus of many public health efforts in the U.S. In 2011-2012, 31.8% of children were at risk for overweight or obesity (Ogden, Carroll, Kit, & Flegal, 2014). According to the Centers for Disease Control and Prevention (CDC), children who are at risk for obesity are also likely to have one or more risk factors of cardiovascular disease (CVD) such as high cholesterol and high blood pressure. Freedman et al. (2007) found that 70% of children with a BMI  $\geq$  the 95<sup>th</sup> percentile of the CDC growth charts had at least one and 39% had two or more risk factors for CVD. Additionally, children classified in this category have an increased risk for developing type 2 diabetes mellitus, sleep apnea, asthma, joint and musculoskeletal discomfort, and remaining obese into adulthood (CDC, 2015).

The rise in childhood obesity has been directed toward the increased availability and consumption of energy-dense and nutrient-poor foods, decreased consumption of low-calorie and high-nutrient food, increased time spent being sedentary, and decreased time spent being physically active. These factors favor a positive energy balance according to the energy balance equation, which favors weight gain (Hall et al., 2012; Spurrier et al., 2016). Studies have identified a link between obesity and poor nutrition habits and obesity and physical inactivity (Dobbins, Husson, DeCorby, & LaRocca, 2013; Skinner, Perrin, Moss, & Skelton, 2015).



## Literature Review

### Physical Activity

#### *Current Recommendations and Trends*

Physical activity for children can improve muscular strength and endurance, build healthy bones and muscles, control weight, improve mental health, increase self-esteem, develop motor skills, and improve blood pressure and cholesterol (CDC, 2015; Dale, Corbin, & Dale, 2000). In the 2014 United States Report Card on Physical Activity for Children and Youth, overall physical activity levels were given a D-, indicating that more than half of the population did not meet the physical activity guidelines of 60 minutes or more of moderate-to-vigorous physical activity (MVPA) on at least 5 days per week (National Physical Activity Plan [NPAP], 2014). Sedentary behavior was given a D, indicating that approximately half the population met the recommendation of only engaging in 2 hours or less per day of screen time according to the 2009-2010 NHANES survey. In the 2010 National Health and Nutrition Examination Survey, children ages 6-11 years old spent on average 5.9 hours per day being sedentary (NPAP, 2014).

#### *Factors Influencing Physical Activity*

Several factors influence whether a child is physically active at desirable levels. Physiological factors include age, gender, and ethnicity (Dobbins et al., 2013). Psychological factors include the child's confidence in his/her exercise/activity, perception of sports/exercise, and enjoyment of physical activity (Dobbins et al., 2013). Factors in the school environment include the presence or absence of organized recess, physical education classes, and whether active transport to and from school is promoted. However, at school, children are in a controlled environment with a set schedule limiting

their ability to be physically active throughout the school day. Dale et al. (2000) found that when children are sedentary throughout the entire school day, they do not compensate for it by increasing their level of physical activity after school. Additionally, the CDC reported that 62% of children between the ages of 9 and 13 do not participate in organized physical activity outside of school (CDC, 2003).

Parental influence after school and in the home environment could help drive children to engage in organized or unorganized physical activity. The Framingham Heart Study reported that children with active parents were six times more likely to be active compared to children with inactive parents (Moore et al., 1991). This influence can be explained through social learning where parents serve as role models and support their children's activity pursuits (Fuemmeler, Anderson, & Masse, 2011). Factors in the home and neighborhood environment that influence children's physical activity levels include accessibility to sports equipment, the age of the neighborhood, size of backyard, safety of neighborhood, household socioeconomic status, and accessibility to parks and facilities (Dale et al., 2000; Dobbins et al., 2013; Hume, Salmon, & Ball, 2005).

Studies have examined physical activity outside of the school environment. Erkelenz et al. (2014) found that a lower child BMI was associated with both parents being physically active. Additionally, children had higher levels of participation in organized sports when they had at least one active parent. Using accelerometry, greater parental MVPA was associated with an increased child MVPA (Fuemmeler et al., 2011). Also, when both parents had high levels of MVPA the child's MVPA was greater indicating that having active parents can be used as a predictor of physical activity in children (Fuemmeler et al., 2011). Tandon et al. (2012) found that low SES households

provided more opportunities for sedentary behaviors such as watching television/DVDs. Hume et al. (2005) found that children's perceptions on some of the factors in the home and neighborhood environment listed above are associated with varying levels of physical activity. Children who had limited physical activity environments at home were more likely to be sedentary compared to children who had access physical activity environments.

### *Physical Activity School-Based Interventions*

Although in a school environment, children have a structured schedule, a school-based intervention to increase physical activity can be effective as it can reach a high a volume of students and it provides benefits to children from all risk groups (Birch, Savage, & Ventura, 2007; Dobbins et al., 2013). For example, children who have limited or no access to play areas or equipment at home can have access at school. Goals created by interventions could be to increase the overall percentage engaged in physical activity each day, to increase the duration of MVPA engaged in on a weekly basis, or to decrease the amount of time spent being sedentary, such as watching television or playing computer games (Dobbins et al., 2013). In order to reach such goals, the intervention would focus on providing the children and teachers information about the benefits of physical activity through educational materials or teacher training. Additionally, recommendations on how to change the format of a school day could be implemented in which more opportunities are offered to students to engage in physical activity at school and they are able to expend greater amounts of energy during the physical activity sessions (Dobbins et al., 2013).

Dobbins et al. (2013) conducted a systematic review to summarize the evidence

of the effectiveness of school-based interventions promoting physical activity. Several primary and secondary outcomes were measured throughout the studies reviewed. Positive effects were seen in the primary outcomes of increasing the duration of physical activity, increasing the participation in MVPA during school hours, and decreasing the amount of time spent watching television.

## Nutrition

### *Current Recommendations and Trends*

According to the 2015-2020 Dietary Guidelines, presented by the United States Department of Health and Human Services (USDHHS) and the United States Department of Agriculture (USDA), for children ages 8-10, the recommended caloric intake per day ranges between 1,400 and 2,200 calories depending on age, sex, and level of physical activity. A healthy eating pattern for a child includes a variety of vegetables from all of the subgroups, including dark green, red and orange, starchy, and other vegetables. Additionally, eating a variety of whole fruits, whole grains, fat-free or low-fat dairy products, protein (seafood, lean meats, poultry, and eggs), legumes (beans and peas), nuts/seeds, and oils should be included in a child's diet. Limitations to consuming saturated and trans fats, added sugars, and sodium are recommended. Specifically, consuming less than 10% of calories per day from added sugars and saturated fats and consuming less than 1,900-2,200 milligrams per day of sodium depending on the child's age (USDHHS & USDA, 2015).

Currently, both male and female children between the ages of 8-10 do not meet the recommended intake for vegetables and dairy (USDHHS & USDA, 2015). The recommended intake for grains and protein are met. However, seafood consumption was

well below the recommended intake, while meat, poultry, eggs, nuts/seeds, and soy products were met (USDHHS & USDA, 2015). Because the current study desires to examine children aged 8-10 years and the Dietary Guidelines split the age groups to 4-8 and 9-13 years, children age 8 meet the recommended fruit intake and children 9 and 10 years old do not. Added sugar consumption is far greater than the recommended intake of 10% or less of calories per day (USDHHS & USDA, 2015). Based on most current data, approximately 16% of a child's calorie intake is from added sugar, 11% is from saturated fat, and children consume approximately 1,000 milligrams of excess sodium (USDHHS & USDA, 2015).

#### *Food Consumption at School*

Children spend approximately 8 hours of the day at school. At school, a child consumes approximately 19-50% of their daily energy intake (Birch et al., 2007). Children in the U.S. may have the option to participate in the School Breakfast Program. In 2012, 12.9 million children participated (USDA, 2015). This program requires the breakfast served to be based on the latest Dietary Guidelines for Americans. In the 2013-2014 school year, the School Breakfast Program offered more whole grains, zero grams of trans fat per portion, and appropriate calories for grades K-5, 6-8, and 9-12. In the 2014-2015 school year, more fruit was served and the first effort to reduce sodium was implemented.

For lunch, approximately 50% of all children participate in the National School Lunch Program (NSLP) (Birch et al., 2007). This requires meals served to be consistent with the Dietary Guidelines for Americans and follow the recommended daily allowance (RDA) for protein, vitamin A, vitamin C, iron, calcium, and calories (Birch et al., 2007).

However, based on measurements of intakes, these requirements are not typically met.

### *Dietary School-Based Interventions*

School-based interventions have been shown to be effective in changing eating behaviors of children, but there has been less success in improving the indicators of obesity (Birch et al., 2007). Intervention strategies implemented at school are cost-effective and allow access to a variety of racial and ethnic groups and socioeconomic statuses. Additionally, programs that target younger children have been shown to be more successful than programs that target adolescents (Birch et al., 2007).

The goal to increase fruit and vegetable consumption during lunchtime has been a focus of several interventions. These interventions focus on improving the availability, accessibility, and exposure of fruits and vegetables. A strategy to increase vegetable consumption in elementary school cafeterias by offering vegetables before other meal components increased the number of students eating vegetables (Elsbernd et al., 2016). A different strategy implemented in the classroom gave each child a free serving of a fruit or vegetable twice a week during a “fruit” break. This strategy led to an increase in the number of fruits and vegetable that were brought to school from home and a decrease in unhealthy snacks being brought from home (Tak, te Velde, Singh, & Brug, 2010).

### *Food Consumption in the Home-Environment*

Several factors influence what a child consumes in the home environment including the availability of fruits and vegetables, frequency of family meals, availability of sugar-sweetened beverages and energy-dense snacks, eating while watching television, taste preference, and parental diet (Santiago-Torres, Adams, Carrel, LaRowe, &

Schoeller, 2014). What a parent eats strongly influences what a child eats as parents consistently make food choices for the family and serve as models. When children observe eating behaviors of others, it influences what they eat. Research has shown that in middle-school-aged children, intake of fruits, vegetables, and milk increased after observing their parents consume the food (Young, Fors, & Hayes, 2004). Similar results have been shown in preschool-aged children (Spurrier, Magarey, Golley, Curnow, & Sawyer, 2008).

In the home environment, studies have examined parental perspectives on food insecurity, family-home nutrition environment, and dietary intake. A more favorable family-home nutrition environment was associated with lower sugar intake and higher vegetable, fruit, and dairy consumption while no significant associations were found between food insecurity and dietary intake (Jackson, Smit, Manore, John, & Gunter, 2015). Another study examined the relationship between the home food environment and diet quality. The study found that 86% of the Healthy Eating Index (HEI) scores were classified as “needs improvement” and 14% were classified as “poor” (Santiago-Torres et al., 2014). Additionally, children with lower HEI scores participated in family meals while watching television and had sugar-sweetened beverages more available. In a study examining the association between home food environment factors and the presence of fruit and vegetables at dinner, there were several positive associations that led to the presence of fruits and vegetables being served at dinner. These included the availability of any form of fruit or vegetable, availability of fresh fruits or vegetables, fruit and vegetable accessibility, parental vegetable intake, and meal planning (Trofholz, Tate, Draxten, Neumark-Sztainer, & Berge, 2016).

### Cardio-metabolic Health

Cardio-metabolic health measures the risk for an individual to develop heart disease or diabetes. Measurements that account for cardio-metabolic health include blood pressure, body composition, and blood cholesterol, triglyceride, and glucose levels measured when a child has been fasting (Kavey et al., 2003). The National Heart, Lung, and Blood Institute (NHLBI) provides desired values for these components for children to help in primary prevention and to classify individuals at risk. Blood pressure readings that are greater than or equal to the 90<sup>th</sup> percentile and below the 95<sup>th</sup> percentile are classified as prehypertension as determined by age and sex. Blood pressure readings greater than or equal to the 95<sup>th</sup> percentile and below the 99<sup>th</sup> percentile are classified as stage 1 hypertension as determined by age and sex. For body composition, waist circumference cut points indicating risk of obesity include measurements greater than or equal to the 90<sup>th</sup> percentile to less than the 95<sup>th</sup> percentile. Cholesterol readings are divided into three components: total cholesterol (TC), low-density lipoproteins (LDL-C), and high-density lipoproteins (HDL-C). Elevated levels of TC and LDL-C are readings greater than or equal to 200 mg/dL and 130 mg/dL. Low levels of HDL-C are readings less than 40 mg/dL. Elevated triglyceride levels are readings greater than or equal to 100 mg/dL for children ages 0-9 or 130 mg/dL for children ages 10-19. Elevated blood glucose levels are readings greater than or equal to 100 mg/dL.

Nutrition strongly influences cardio-metabolic health in children. The components of a child's diet can influence one or multiple factors listed above. High sodium intake can increase blood pressure and unfortunately, snacks that are attractive to children are high in sodium (Funtikova, Navarro, Bawaked, Fito, & Schroder, 2015; Kavey et al.,



2003). A higher consumption of total, unsaturated, and saturated fats and myristic fatty acids is associated with increased TC (Funtikova et al., 2015). The amount and type of dairy a child consumes influences how the cardio-metabolic markers can fluctuate. Bigornia et al. (2014) showed that children who consumed higher amounts of full-fat and reduced-fat dairy products had 43% and 26% lower probability of being overweight or having excessive body fat in 3 years. Additionally, there is a hypothesis that the increase in low-fat milk consumption and decrease in whole milk consumption is related to an increased inflammatory response (Funtikova et al., 2015). What is agreed upon in the research is that there is an inverse association between dairy consumption and increased blood glucose levels and insulin resistance (Funtikova et al., 2015). Fruits and vegetables have been shown to have a protective association with obesity. More than two servings per day of fruit or vegetables is associated with reduced blood pressure and there is further decrease in blood pressure when fruits and vegetables are combined (Funtikova et al., 2015; Kavey et al., 2003). Children who eat a high fiber breakfast have been found to have lower insulin resistance and fasting blood glucose levels (Funtikova et al., 2015). The type and amount of meat children consume can impact TC, LDL-C, HDL-C, and triglyceride levels. There is a direct association between the frequency of red meat consumption and dyslipidemia in children aged 11-18 (Funtikova et al., 2015).

Sugar-sweetened beverage consumption in relation to cardio-metabolic health amongst children has been a strong area of interest. Research indicates that high consumption of sugar-sweetened beverages leads to an increase in waist circumference, markers of inflammation, and BMI and a decrease in HDL-C (Funtikova et al., 2015). Additionally, it is associated with obesity, hypertension, and dyslipidemia. Sharma et al.

(2010) found that an increase in carbohydrate energy in the form of sugar was associated with increases in multiple classes of lipids and an increase in insulin resistance, which is related to the risk of diabetes.

Physical activity also contributes to the components of cardio-metabolic health in children. Total physical activity is inversely associated with waist circumference, blood glucose, and triglycerides (Ekelund et al., 2012). MVPA is inversely associated with all cardio-metabolic outcomes (Ekelund et al., 2012). Children who participate in higher levels of MVPA during the school day (accumulate more than 35 minutes per day) are found to have significantly lower values of waist circumference, systolic blood pressure (SBP), fasting blood glucose and triglycerides, and higher values of HDL-C in comparison to children who participate in lower levels of MVPA (18 minutes per day) (Ekelund et al., 2012). Additionally, children who participate in higher levels of MVPA have more favorable metabolic health regardless of the amount of time spent sedentary.

### Statement of the Problem

While many interventions have made efforts towards improving children's dietary and physical activity habits in the school environment, fewer have examined them in the home environment and particularly their relationship to various cardio-metabolic health markers. The studies examining the home environment have primarily focused their efforts from the parental perspective without taking the child's input into account. Parental dietary behaviors have been shown to strongly influence the child's dietary behaviors (Zarychta, Mullan, & Luszczynska, 2015). However, what the parent perceives and what the child perceives could vary. Therefore, surveying the child could give a different perspective on the topic. Additionally, focusing on after-school physical activity

habits and dietary habits in the home-environment may have a strong influence on a child's cardio-metabolic health. This could be used as an early prevention mechanism to decrease the risk of developing disease and premature mortality.

### Study Aims and Hypotheses

The purpose of this study was to determine the predictive relationship between after-school physical activity and dietary habits in the home environment to cardio-metabolic risk in a sample of elementary-school-aged children from low-income families. Therefore, the following aims were proposed:

AIM 1: To determine if there was a relationship between after-school nutrition in the home environment and a metabolic syndrome composite score.

HYPOTHESIS 1: Healthy after-school nutrition will be inversely related to a lower (more favorable) metabolic syndrome composite score where healthy is identified as a higher score on the nutrition questionnaire.

AIM 2: To determine if there was a relationship between after-school physical activity and metabolic syndrome composite score.

HYPOTHESIS 2: Higher after-school physical activity will be inversely related to a lower (more favorable) metabolic syndrome composite score.

SECONDARY AIM 1: To examine the relationship between after-school physical activity and nutrition scores.

SECONDARY HYPOTHESIS 1: A higher after-school physical activity score will be directly related to a higher after-school nutrition score.

### Significance of the Study

With the primary focus to improve children's health coming from school-based interventions, the findings from this study could help establish a better understanding of how after-school behaviors impact health. The completion of this study could contribute to the understanding of whether or not after-school nutrition and physical activity strongly influence cardio-metabolic health in children. These findings could assist in creating better home interventions and after-school programming as well by determining the key components that have a more significant impact on cardio-metabolic health as compared to others.

## METHODS

### Participants

An a priori power analysis was conducted using G\*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). Using an assumed medium sized effect ( $f^2 = 0.15$ ), a two-sided alpha level of 0.05, and 80% statistical power, the recommended sample size was 77 participants for a multiple linear regression analysis with two predictor variables. The total recruited sample size was 92 participants. The participants were a convenience sample of children (3<sup>rd</sup> – 6<sup>th</sup> grades) recruited from five Title I schools located in a metropolitan area from the Mountain West region of the United States. Fifty-six point five percent of the participants were females and 43.5% were males. The majority of the children that participated in this study came from low-income families. Written assent was obtained from each child and written, informed consent was obtained from one parent prior to data collection. The University Institutional Review Board approved the protocols in this study.

### Instrumentation

#### After-School Nutrition

After-school nutrition data were collected using a portion of a 58-item questionnaire called the After-School Student Questionnaire (ASSQ), which can be found in the appendix. The questionnaire examines food preferences, dietary knowledge, self-

efficacy, intentions to choose healthful food options, and participation in sedentary activities and sports activities (Kelder et al., 2005). In a pilot-study of the questionnaire, it had an acceptable internal consistency (Kelder et al., 2005). For the purpose of this study, only the nutrition behavior and food recall related sections were reported. This included questions 1-10, 18, 20-23, 25, while questions 11-17, 19, 24, 26-58 were not included in data collection. Questions 5-10 were each given a score between 0 and 3. Questions 18, 20-25 were each given a score between 0 and 2. The sum of all the scores was collected from the responses to be used as the total score. A higher score indicated better after-school nutrition. Scores could range from 0 to 30.

#### After-School Physical Activity

After-school physical activity was collected using a portion of the Physical Activity Questionnaire for Older Children (PAQ-C), which can be found in the Appendix. This questionnaire is designed for children ages 8-14 who have recess as a regular part of their school week. It is a self-administered, 7-day recall of general MVPA levels. There is evidence for this instrument to be a reliable and valid measure of general physical activity levels in children during the school year (Kowalski, Crocker, & Donen, 2004). For the purpose of this study, only the questions pertaining to after-school physical activity were reported. This included questions 1, 5-10, while questions 2-4 were not included. For scoring, each question is worth 5 points each where 1 point represents the selection of the lowest physical activity response and 5 points represents the selection of the highest physical activity response. Question 10 was not scored in this manner as it is used to identify students who had unusual activity during the week. The mean of all the scores was then taken to find the final score where 1 indicates low physical activity and 5

indicates high physical activity. Further directions on how to obtain a composite score for each question is further described in the Physical Activity Questionnaire Manual (Kowalski et al., 2004).

#### Cardio-metabolic measures

Waist circumference was measured at the level of the superior border of the iliac crest on the participant's right side using a Gulick tape measure (Country Technology, Inc., Gays Mills, WI). All measurements were estimated to the nearest 1 cm.

Blood pressure was measured using an electronic blood pressure device (CONTEC08A, Contec Medical Systems Co., Qinhuangdao, China). SBP and diastolic blood pressure (DBP) measurements were taken on each participant's right arm. Their right arm was rested and elevated at heart level and both feet were flat on the ground.

Each student's blood lipid profile was collected using the Cholestech LDX system (Alere Inc., Waltham, MA, USA). Individual biomarkers included TC, LDL-C, HDL-C, triglycerides, and blood glucose. A capillary blood sample was collected before the beginning of the school day between 6:30 am and 8 am. Blood samples were collected in a fasted state, which was verbally verified by the student. Blood samples were collected via a finger stick on each of the student's right index finger using a 40- $\mu$ L capillary tube. The blood was immediately injected into the Lipid Profile-Glucose Cassette (Alere Inc., Waltham, MA, USA) for analysis. The puncture site was then cleaned and bandaged. Disposal of all materials was placed in a biohazard container. This technique was feasible and easy to administer. Precision and accuracy of the Cholestech LDX are within the guidelines of the National Cholesterol Education Program (Issa, Strunz, Giannini, Forti, & Diamant, 1996).

### Procedures

The study commenced in April 2016 and continued for approximately 4 weeks. Children arrived to school from an overnight fast between the hours of 6:30 am and 8 am, which was verbally confirmed by the student. A blood sample was collected via a finger stick using a 40- $\mu$ L capillary tube. The blood was then placed in a Lipid Profile-Glucose Cassette and analyzed using the Cholestech LDX. Following the blood sample, the children had their blood pressure and waist circumference measured. Two questionnaires were then administered to the children. The AASQ was completed first and the PAQ-C was completed after the completion of the ASSQ. Children were assisted if they needed help reading or understanding questions and were given as much time as needed to complete the questionnaires.

### Data Processing

A continuous and age- and sex-adjusted metabolic syndrome composite score (MetS) was calculated using each child's fasting triglycerides, blood glucose, HDL cholesterol, waist circumference, and SBP and DBP. An estimated mean arterial pressure (MAP) score was calculated from the SBP and DBP values using the equation:  $MAP = ((2 \times DBP) + SBP) / 3$ . The MAP score was used for derivation of MetS as it incorporates both SBP and DBP into a single measure. Derivation of the MetS scores included regressing each child's age and sex onto the aforementioned parameters and calculating an individual standardized score (z-score) per measure. Because HDL cholesterol is inversely related to cardio-metabolic risk, the HDL z-score was multiplied by  $-1$ . The MetS was the sum of all calculated age- and sex-adjusted z-scores. A higher MetS score will represent a more unfavorable cardio-metabolic profile. The following procedures are



in accordance to those given by Eisenmann et al. (2010).

### Data Analysis

The design of this study was a cross-sectional and correlational. Because there was no linear relationship between the predictor variables (physical activity and nutrition scores) and the criterion variable (MetS), further analyses were not justified. Instead, a secondary analysis was conducted to examine the relationship between physical activity scores and nutrition scores using physical activity score as the predictor variable and nutrition score as the criterion variable. Poor food intake and physical inactivity are the two most relevant factors associated with weight gain in children (Dobbins et al., 2013; Skinner et al., 2015). The regression model of statistical assumptions was checked including linearity using a scatter plot matrix, normal distributions of residuals using a histogram, homoscedasticity using a residual versus fitted plot, and multicollinearity using leverage and tolerance statistics. Other covariates entered into the model included age and sex to control for any potentially moderating effects that were tested using interaction terms. Only predictor variables that displayed statistical significance were included in the final model. Alpha level was set a  $p \leq 0.05$  and all analyses were carried out using SPSS version 23.0 statistical software package (Armonk, NY, USA).

## RESULTS

### Demographics

The demographic characteristics of the sample are presented in Table 1. Of the 92 total participants, 56.5% were females and 43.5% were males. Over half of the participants were either 9 or 10 years of age (60.8%) and almost half of the participants were of a Hispanic/Latino ethnic background (45.7%). Three subjects did not indicate their ethnicity on the survey.

### Correlations

Table 2 provides the descriptive statistics for the total sample and within each sex. Table 3 is a correlation matrix displaying the Pearson correlation coefficients among MetS scores, nutrition scores, physical activity scores, and the components that make up the MetS score. The nutrition scores displayed a linear, positive, moderate correlation with the physical activity scores ( $r = 0.29, p < 0.05$ ). Figure 1 is scatter plot showing the relationship between nutrition scores and physical activity scores. Nutrition scores also displayed a linear, negative, weak correlation with HDL levels ( $r = -0.22, p < 0.05$ ).

Comparing correlations within sexes, males displayed a linear, positive, moderate correlation ( $r = 0.46, p < 0.05$ ) between nutrition scores and physical activity scores, while females did not show a significant relationship ( $r = 0.16, p = 0.24$ ). Females showed a linear, negative, moderate correlation ( $r = -0.33, p < 0.05$ ) between nutrition scores and

Table 1. Demographic characteristics.

Demographic	<i>n</i>	%
<b>Gender</b>		
Boys	40	43.5
Girls	52	56.5
Total	92	100
<b>Age</b>		
8	11	12
9	29	31.5
10	27	29.3
11	18	19.6
12	7	7.6
Total	92	100
<b>Ethnicity</b>		
Caucasian	12	13
Hispanic/Latino	42	45.7
Asian/Pacific Islander	12	13
American Indian/Alaskan Native	3	3.3
Other	20	21.7
Total	89	100

Table 2. Descriptive statistics showing the mean (*SD*).

	Total ( <i>N</i> = 92)	Girls ( <i>n</i> = 52)	Boys ( <i>n</i> = 40)
MetS	0.00 (2.96)	-0.22 (2.67)	0.28 (3.30)
Nutrition Score	15.97 (3.38)	15.85 (3.43)	16.13 (3.34)
PA Score	2.92 (0.75)	2.85 (0.62)	2.99 (0.89)
HDL (mg/dL)	48.68 (12.40)	46.60 (11.81)	51.40 (12.75)
TRI (mg/dL)	105.86 (55.78)	107.33 (57.29)	103.95 (54.43)
BG (mg/dL)	92.27 (12.11)	90.25 (10.50)	94.90 (13.62)
WC (cm)	72.59 (12.39)	71.29 (11.63)	74.28 (13.28)
MAP (mmHg)	79.24 (9.78)	77.87 (8.88)	81.02 (10.69)

Note: MetS = Metabolic Syndrome score, PA = physical activity, HDL = high density lipoproteins, TRI = triglycerides, BG = blood glucose, WC = waist circumference, MAP = mean arterial pressure

Table 3. Correlation matrix.

	MetS	Nutrition Score	PA Score	HDL	TRI	BG	WC	MAP
MetS	1							
Nutrition Score	-0.02	1						
PA Score	0.04	<b>0.29*</b>	1					
HDL	<b>-0.65</b>	<b>-0.22</b>	-0.03	1				
TRI	<b>0.57</b>	-0.09	0.01	<b>-0.45</b>	1			
BG	<b>0.47</b>	-0.20^	0.12	0.00	0.01	1		
WC	<b>0.68</b>	-0.03	-0.09	<b>-0.42</b>	<b>0.22*</b>	0.02	1	
MAP	<b>0.59</b>	-0.03	0.04	-0.05	0.00	<b>0.35</b>	<b>0.35</b>	1

Note: MetS = Metabolic Syndrome score, PA = physical activity, HDL = high-density lipoproteins, TRI = triglycerides, BG = blood glucose, WC = waist circumference, MAP = mean arterial pressure. **Bold** = statistically significant ( $p < 0.05$ ). \* = statistically significant for males only ( $p < 0.05$ ). ^ = statistically significant for females only ( $p < 0.05$ ).

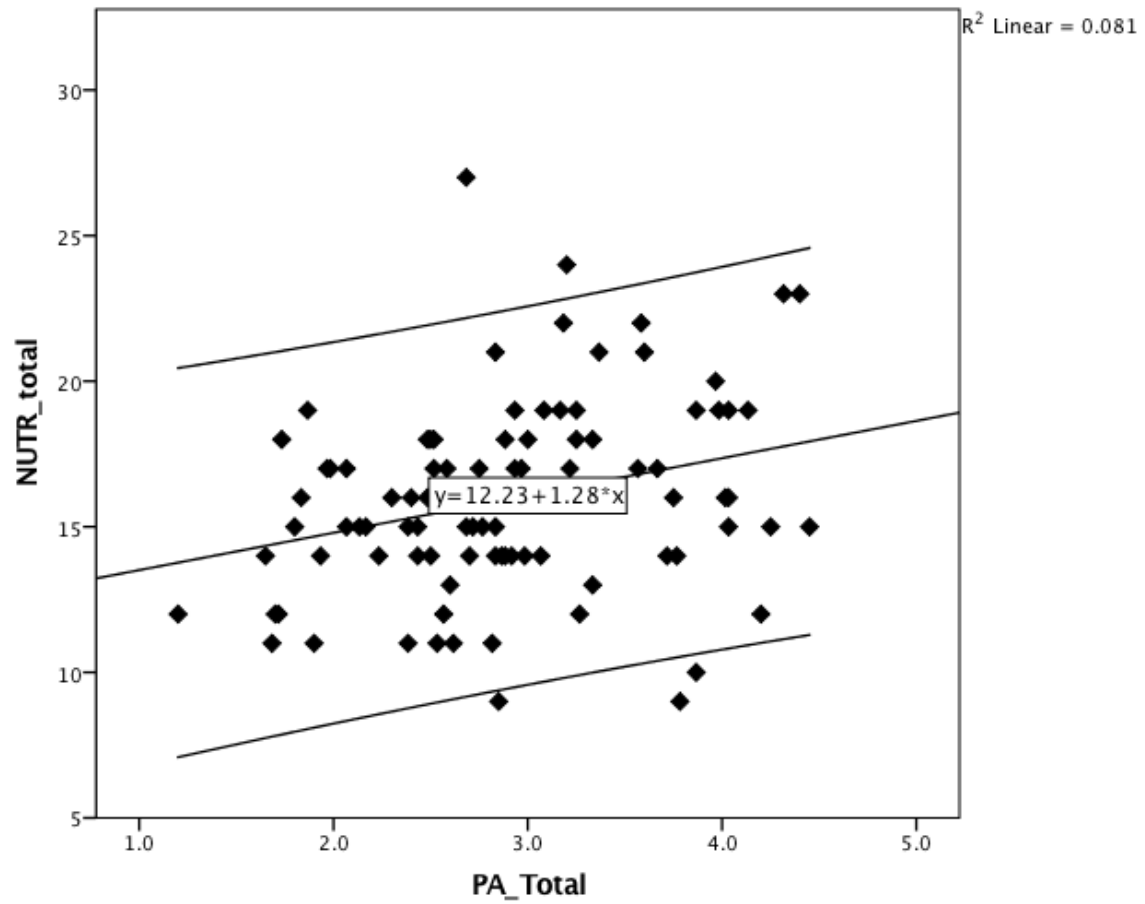


Figure 1. Scatter plot with line of best-fit and 95% CI showing the linear relationship between nutrition and physical activity scores.

blood glucose levels and males did not show a significant relationship ( $r = -0.08, p = 0.62$ ). Males displayed a linear, positive, moderate correlation ( $r = 0.41, p = < 0.05$ ) between waist circumference and triglyceride levels and female did not show a significant relationship ( $r = 0.08, p = 0.59$ ).

Because there was no statistical significance between the correlations of physical activity and MetS score ( $r = 0.04, p = 0.72$ ), and nutrition and MetS score ( $r = -0.02, p = 0.84$ ), a multiple linear regression analysis using MetS as the dependent variable and nutrition and physical activity scores as predictor variables was not conducted. However, because there was a correlation between the nutrition and physical activity scores, a secondary analysis was conducted using the nutrition score as the criterion variable and physical activity score as a predictor variable. Age and sex were included as additional predictor variables. Results from this analysis are displayed in Table 4.

#### Linear Regression Analysis

Model 1 explained 8.1% of the variance in the nutrition score and was statistically significant ( $F = 7.93, p = 0.006$ ) and model 2 explained 8.9% of the variance and was statistically significant ( $F = 2.85, p = 0.04$ ). However, the change statistic for model 2 was not statistically significant, indicating that model 1 provides a better model representation of the sample data. Therefore, the linear equation based on the final model parameters would be Nutrition Score =  $12.23 + 1.28 \times (\text{PA Score})$ . The linear model indicates that a one-unit increase in PA score is associated with 1.28-unit increase in nutrition score. Figure 2 represents a residual versus fitted plot verifying the statistical assumption of homoscedasticity has been met.

Table 4. Linear model of predictors of nutrition score.

Model		B - coefficient	95% CI	P-value
1	Constant	12.23	9.51 – 14.95	0.00
	PA Score	<b>1.28</b>	<b>0.38 – 2.19</b>	<b>0.01</b>
2	Constant	14.82	8.21 – 21.44	0.00
	PA Score	<b>1.29</b>	<b>0.38 – 2.21</b>	<b>0.01</b>
	Sex	-0.15	-1.53 – 1.23	0.83
	Age	-0.26	-0.87 – 0.35	0.40

Note: PA = physical activity



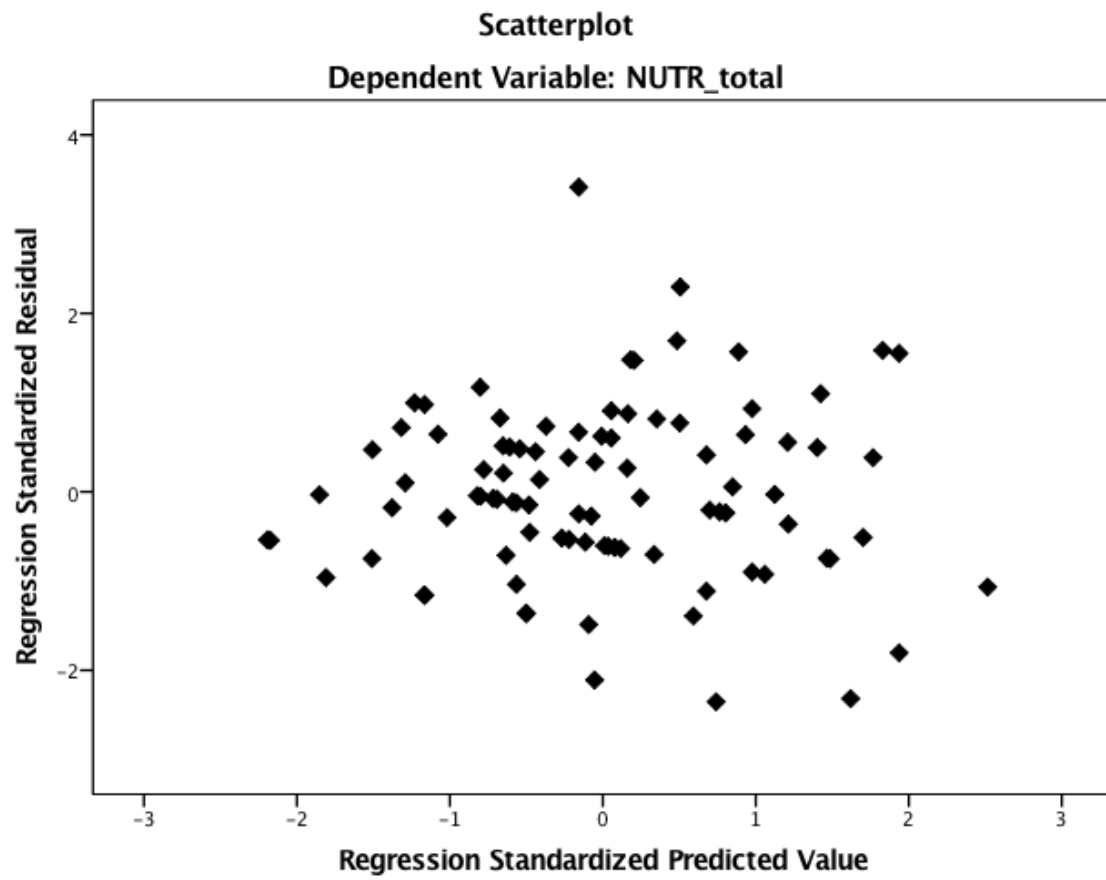


Figure 2. Residual versus predicted plot.

## DISCUSSION

The purpose of this study was to determine a predictive relationship between after-school physical activity and nutrition habits to a composite score reflective of metabolic syndrome in elementary-school-aged children from low-income families. The primary finding from this study was that after-school physical activity and nutrition habits reported via survey do not predict cardio-metabolic risk in children from low-income families. A secondary analysis was conducted to characterize the relationship between after-school physical activity and after-school nutritional habits. The finding from this analysis indicated that for a 1-unit increase in the physical activity score, there would be a 1.28-unit increase in the nutrition score.

### Significance of Findings

#### Metabolic Syndrome

From the findings of this study, the null hypotheses failed to be rejected. Metabolic syndrome is defined as the combination of adverse cardiovascular disease and metabolic risk factors (Eisenmann et al., 2010). These risk factors include elevated abdominal obesity, blood pressure, fasting blood glucose, triglycerides, and lowered HDL- C (Eisenmann et al., 2010, NHLBI, 2011). To exhibit metabolic syndrome, an individual has three or more of the identified risk factors. For this study's population, elevated values would include greater than or equal to the 90<sup>th</sup> percentile adjusted for age

and sex for waist circumference and blood pressure, fasting glucose greater than or equal to 100 mg/dL, triglycerides greater than or equal to 100 mg/dL for 8 and 9 year olds and 130 mg/dL for 10-12 year olds, and HDL-C less than or equal to 40 mg/dL (NHLBI, 2011). There is no universal definition for metabolic syndrome in children and adolescents, but Eisenmann et al. (2010) describes how they and other researchers have derived a continuous metabolic syndrome score that represents a composite cardiovascular disease/metabolic risk factor profile. This method is what was used in this study and how the composite score was determined can be found in the methods section.

There is a lack of consistent evidence showing an inverse relationship between physical activity and a continuous MetS score in children. Several factors must be considered, including level of physical activity, age, sex, and form of measurement. This provides a challenge when determining a relationship. Ekelund et al. (2007) reported an inverse relationship between MVPA and MetS score in 9 to 15 year olds, while DuBose et al. (2015) reported MetS was not related to physical activity regardless of the intensity or meeting physical activity recommendations. Inconsistency in the literature calls for a further understanding of whether physical activity levels have a relationship to MetS, in particular, focusing on whether a particular age, sex, or physical activity level has a greater relationship.

Nutrition can directly impact the risk factors that make the metabolic syndrome. For example, high sodium intake can increase blood pressure (Funtikova et al., 2015; Kavey et al., 2003). Also, children who eat a high fiber breakfast have been found to have lower fasting blood glucose levels (Funtikova et al., 2015). Lastly, the type and amount of meat children consume can impact TC, LDL-C, HDL-C, and triglyceride levels

(Funtikova et al., 2015). The nutrition survey utilized in this study only asked about what each child consumed the day prior to completion of the survey in the home environment. Perhaps a week-long food log including all food consumed would have given a better idea of each child's nutrition habits.

When examining the components of the MetS and comparing them to the values listed above, 80.4% of participants had favorable HDL-C, 55% of participants between 8 and 9 years old had favorable triglyceride levels, and 80.8% of participants between 10 and 12 years old had favorable triglyceride levels. Additionally, 83.7% had fasting blood glucose values below 100 mg/dL. For blood pressure, 81.8% of 8 year olds, 70% of 9 year olds, 59.3% of 10 year olds, 77.8% of 11 year olds, and 85.7% of 12 year olds had SBP readings and for DBP, 100% of 8 year olds, 93.1% of 9 year olds, 77.8% of 10 year olds, 94.4% of 11 year olds, and 100% of 12 year olds had readings below 90<sup>th</sup> percentile adjusted for age and sex. The percentage of children who were under the 90<sup>th</sup> percentile for waist circumference adjusted for age and sex include 90.9, 82.8, 77.8, 94.4, and 85.7 for 8, 9, 10, 11, and 12 year olds, respectively (CDC, 2012). Overall, the majority of children in this study exhibited favorable cardio-metabolic health. In fact, 84.8% of the subjects had two or fewer of the risk factors for metabolic syndrome and 40.2% of subjects displayed none of the risk factors. With low variability, it is difficult to establish a relationship between the predictor and outcome variables.

It is important to consider that 72.8% of the children were 10 years old or younger, indicating that the majority of the children were most likely prepubescent or in the early stages of puberty. The average age for the onset of puberty in girls occurs between 8 and 13 years of age with menarche typically occurring 2-2.5 years after the

onset of puberty. The average age of menarche is between 12-12.5 years old (Wolff & Long, 2016). The average age for the onset of puberty in boys occurs between 9 and 14 years of age with the mean age being 11.64 (Wolf & Long, 2016).

### Puberty and Cardiometabolic Health

Puberty has been shown to have an effect on cardio-metabolic health markers especially ones that influence the MetS (Bloch, Clemons, & Sperling, 1987; Jessup & Harrell, 2005; Wolff & Long, 2016). Additionally, Brambilla et al. (2007) suggest that the characteristics of metabolic syndrome are influenced by growth and puberty. One physical change that occurs during the puberty and predominantly in girls is the increase in body fat. Studies have also indicated this occurs in boys, but the results are conflicting (Jessup & Harrell, 2005). Whether the increase in body fat is due to puberty or if there are other contributing factors such as decrease in physical activity and change in diet with aging is in question. Central accumulation of body fat can be indicated through changes in waist circumference. Body fat located in the central region of the body and estradiol levels have been shown to be related (Davison, Susman, & Birch, 2003). Lipid levels have also been shown to vary through each of the pubertal stages (Jessup & Harrell, 2005). For example, TC has been shown to drop mid-puberty and then rise to adult levels towards the end. Conducting a longitudinal study that tracks change occurring throughout pubertal years would be helpful to better understand factors contributing to metabolic syndrome during this important period of development.

Analyzing cardio-metabolic health in prepubertal children is challenging. Several considerations need to be taken into account along with puberty, including age, ethnicity, and sex (Bloch et al., 1987; Jessup & Harrell 2005; Wolff & Long, 2016). Being able to

identify risk for MetS early in life is important to trigger lifestyle changes that may improve health outcomes later in life. Further research is needed in tracking changes in the risk factors for metabolic syndrome in children as they transition from childhood and into adolescence.

### Physical Activity and Nutrition Relationship

Although not a primary aim of the study, it is important to note the relationship between physical activity and nutrition scores that was identified in the secondary analysis. This analysis found that for a 1-unit increase in the physical activity score, there would be a 1.28-unit increase in the nutrition score. Sallis et al. (2000) found, in children ages 4-12, a positive association between physical activity and a healthy diet. This is important in that both components are contributors to altering cardio-metabolic health (Ekelund et al., 2012; Funtikova et al., 2015). Therefore, when creating interventions to promote physical activity or healthy eating habits in children, it is important to consider that focusing on one of the components only may bring benefits to the other. An intervention that has successfully increased the intake of fruits and vegetables during lunch could lead to a secondary outcome of children increasing their levels of physical activity. This could arise from the conceptual relationship that a healthier diet leads to increased energy levels leading to an increase in physical activity. This concept should be examined in future research.

### Future Research and Limitations

School-based interventions have been effective as they reach a high volume of students in one setting (Dobbins et al., 2013). Because of this, school-based interventions

are the most popular forms of interventions to promote physical activity and healthy nutritional habits. However, moving forward, more research needs to be done on ways to implement successful interventions in the home environment or other environments outside of school as well. One way this could be done is by using interventions with a holistic approach. Interventions that originate at school have potential to translate over into the home environment. Tak et al. (2010) showed this through promoting a fruit break twice a week in the classroom. After this intervention, more fruits and vegetables were brought from home as a snack during the school day. Additionally, interventions should focus on targeting children at a younger age. Birch et al. (2007) found that programs that targeted children were more effective than programs that targeted adolescents. Targeting younger children could also help instill a culture where physical activity and healthy eating habits are important and a part of the norm.

There are limitations to this study that should be considered. First, the use of questionnaires created potential for bias of self-report. Self-reporting via questionnaires is beneficial in that it allows the researcher to collect from a large number of individuals and it is cost effective (Welk, Corbin, & Dale, 2000). However, there can be drawbacks to using questionnaires especially with children. These drawbacks include the potential of the child overreporting based on what they believe is the desired answer, recall being a highly cognitive task, and easy misunderstanding of what the question may ask (Welk et al., 2000). Although both questionnaires used in the study have shown evidence for being both reliable and valid, there is still potential for response and recall bias in this specific sample of school-aged children. For this study, the surveys were only administered once. It may have been helpful to administer the survey multiple times to account for variability

that may occur in diet and physical activity on a daily and weekly basis (Welk et al., 2000). Due to time constraints, this could not be done, but should be considered for future research. Second, the convenience sample consisted of low-income children from the Mountain West region of the U.S. Because of this, the external validity of the results is questionable if generalized to other samples with different ethnic and/or socio-economic backgrounds. Finally, this study was only able to establish correlation and not causation.

Understanding how the home environment and other environments outside of school influence children's physical activity and nutritional habits in relation to cardio-metabolic health is a topic that needs further research. Future research on this topic should consider using objective measurements for physical activity and nutrition habits, as this would give a more accurate assessment (Welk et al., 2000). If questionnaires were to be utilized again, it would be important to ensure the children are adequately trained to complete the questionnaire successfully and are closely monitored. Parental aid should also be a consideration taken into account especially in food recall. Additionally, knowing whether a child is prepubescent, going through puberty, or postpuberty is an important consideration. Hormone measurement or assessing the onset and development of puberty according to Tanner stages could be a consideration (Marshall & Tanner, 1969; Marshall & Tanner, 1970). Puberty can influence components of MetS. It may also be more ideal to choose an age range that does not have as much variance in the potential stages of puberty that could be occurring between 8 and 12 year olds.

### Conclusion

In conclusion, self-reported, after-school physical activity and nutrition did not predict a composite MetS score in children aged 8 to 12. The inability to predict a MetS



score may have risen from many factors. The need to further the understanding of how physical activity and nutrition outside of the school environment impact cardio-metabolic health is of great importance. A better understanding could assist in creating more effective home-based interventions and after-school programs. Additionally, identifying how environments outside of school impact cardio-metabolic health could improve identification of health risks and diseases that children could encounter in later years of life.

## APPENDIX

### QUESTIONNAIRES

After-School Student Questionnaire

The following questions ask about foods and meals you eat, and what you know about nutrition and physical activity. **This is not a test.** We want to learn about what kids your age eat and know about nutrition and about physical activity.

The answers you give will be kept private. No one will ever know what you say unless you tell them. Your name will never be used.

Please be as honest as you can.

1. What grade are you in? \_\_\_\_\_

2. How old are you? \_\_\_\_\_ years old

3. Are you a boy or a girl? ☐ Boy  
☐ Girl

4. How do you describe yourself?

- ☐ White
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Asian or Pacific Islander
- ☐ American Indian or Alaskan Native
- ☐ Other

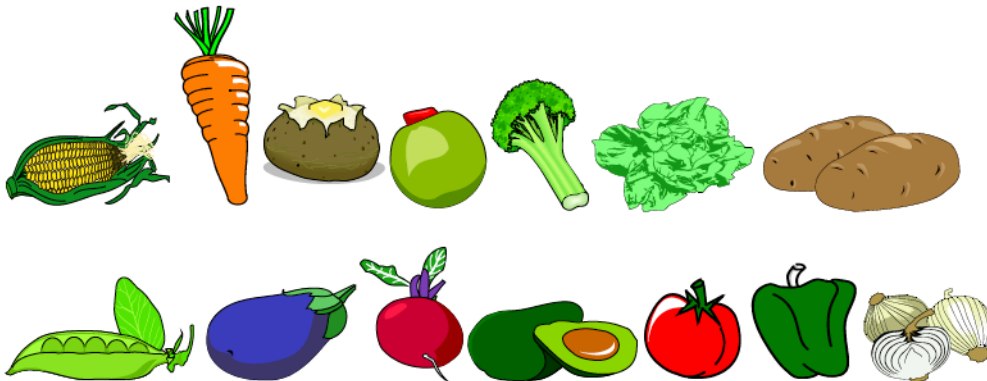
**INSTRUCTIONS:** Please CIRCLE your answer.

5. Yesterday, did you eat French fries or chips?  
Chips are potato chips, tortilla chips, cheetos, corn chips, or other snack chips.



- a. No, I didn't eat any French fries or chips yesterday.
- b. Yes, I ate French fries or chips **1 time** yesterday.
- c. Yes, I ate French fries or chips **2 times** yesterday.
- d. Yes, I ate French fries or chips **3 or more times** yesterday.

6. Yesterday, did you eat any vegetables?  
**Vegetables** are salads; boiled, baked and mashed potatoes; and all cooked and uncooked vegetables.  
Do not count French fries or chips.



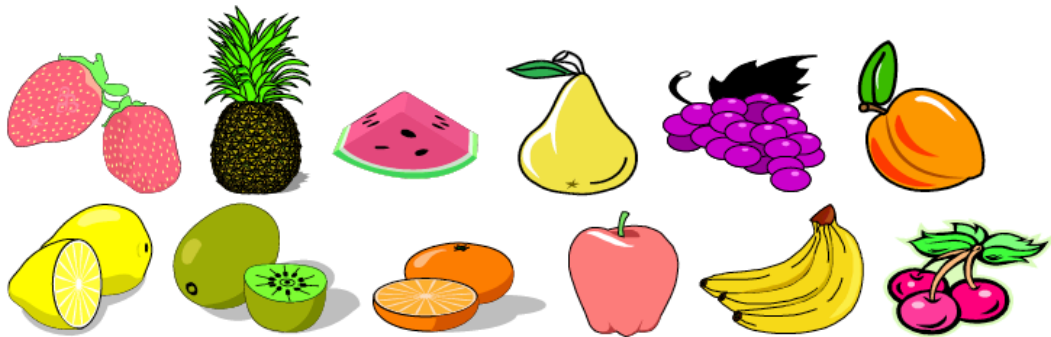
- a. No, I didn't eat any vegetables yesterday.
- b. Yes, I ate vegetables **1 time** yesterday.
- c. Yes, I ate vegetables **2 times** yesterday.
- d. Yes, I ate vegetables **3 or more times** yesterday.

7. Yesterday, did you eat beans such as pinto beans, baked beans, kidney beans, refried beans, or pork and beans?  
Do not count green beans.



- a. No, I didn't eat any beans yesterday.
- b. Yes, I ate beans **1 time** yesterday.
- c. Yes, I ate beans **2 times** yesterday.
- d. Yes, I ate beans **3 or more times** yesterday.

8. Yesterday, did you eat fruit?  
Do not count fruit juice.



- a. No, I didn't eat any fruit yesterday.
- b. Yes, I ate fruit **1 time** yesterday.
- c. Yes, I ate fruit **2 times** yesterday.
- d. Yes, I ate fruit **3 or more times** yesterday.

9. Yesterday, did you drink fruit juice?

Fruit juice is a drink, which is 100% juice, like orange juice, apple juice, or grape juice.

Do not count punch, kool-aid, sports drinks, and other fruit-flavored drinks.



- a. No, I didn't drink any fruit juice yesterday.
- b. Yes, I drank fruit juice **1 time** yesterday.
- c. Yes, I drank fruit juice **2 times** yesterday.
- d. Yes, I drank fruit juice **3 or more times** yesterday.

10. Yesterday, did you eat sweet rolls, doughnuts, cookies, brownies, pies, or cake?



- a. No, I didn't eat any of the foods listed above yesterday.
- b. Yes, I ate one of these foods **1 time** yesterday.
- c. Yes, I ate one of these foods **2 times** yesterday.
- d. Yes, I ate one of these foods **3 or more times** yesterday.

18. Do you ever read the nutrition labels on food packages?

- a. Almost always or always
- b. Sometimes
- c. Almost never or never

- 20. The foods that I eat and drink now are healthy.**
- a. Yes, all of the time
  - b. Yes, sometimes
  - c. No
- 21. Do you ever eat high fiber cereal?**
- a. Almost always or always
  - b. Sometimes
  - c. Almost never or never
- 22. Do you ever eat whole wheat bread?**
- a. Almost always or always
  - b. Sometimes
  - c. Almost never or never
- 23. Do you ever drink 100% fruit juice?**
- a. Almost always or always
  - b. Sometimes
  - c. Almost never or never
- 25. Do you ever eat vegetables for dinner?**
- a. Almost always or always
  - b. Sometimes
  - c. Almost never or never

## Physical Activity Questionnaire – Children

### *Physical Activity Questionnaire (Elementary School)*

Name: \_\_\_\_\_

Age: \_\_\_\_\_

Sex: M \_\_\_\_\_ F \_\_\_\_\_

Grade: \_\_\_\_\_

Teacher: \_\_\_\_\_

We are trying to find out about your level of physical activity from *the last 7 days* (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

**Remember:**

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

	No	1-2	3-4	5-6	7 times or more
Skipping .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rowing/canoeing .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In-line skating .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tag .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Baseball, softball .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Skateboarding .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Soccer .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Street hockey .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Floor hockey .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice skating .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cross-country skiing .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice hockey/ringette .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other: .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ..... ☐  
 1 time last week ..... ☐  
 2 or 3 times last week ..... ☐  
 4 times last week ..... ☐  
 5 times last week ..... ☐

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ..... ☐  
 1 time last week ..... ☐  
 2 or 3 times last week ..... ☐  
 4 or 5 last week ..... ☐  
 6 or 7 times last week ..... ☐

7. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None ..... ☐  
 1 time ..... ☐  
 2 — 3 times ..... ☐  
 4 — 5 times ..... ☐  
 6 or more times ..... ☐

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you.

- A. All or most of my free time was spent doing things that involve little physical effort ..... ☐  
 B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics) ..... ☐  
 C. I often (3 — 4 times last week) did physical things in my free time ..... ☐  
 D. I quite often (5 — 6 times last week) did physical things in my free time ..... ☐  
 E. I very often (7 or more times last week) did physical things in my free time ..... ☐

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week.

	None	Little bit	Medium	Often	Very often
Monday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tuesday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wednesday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thursday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saturday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sunday .....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes ..... ☐

No ..... ☐

If Yes, what prevented you? \_\_\_\_\_

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